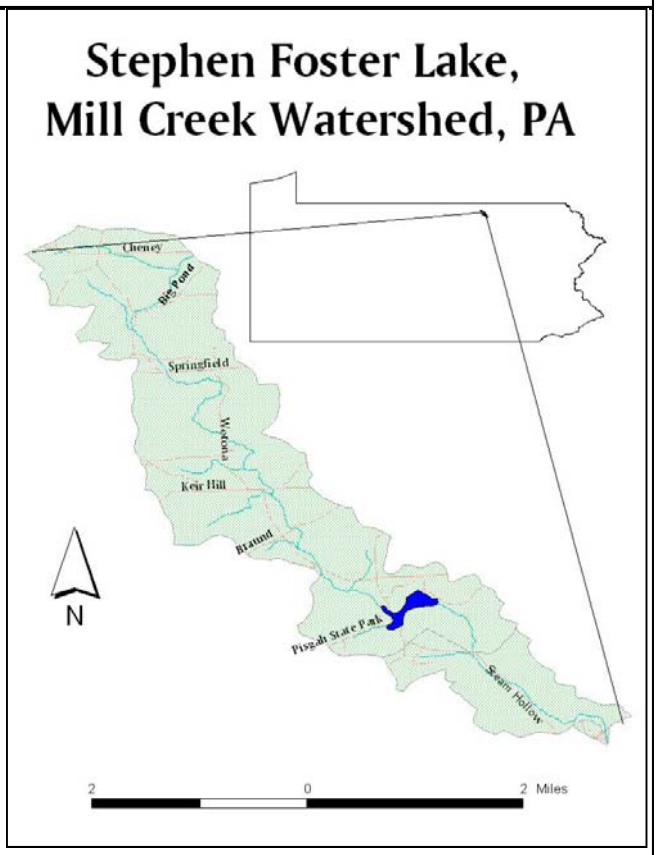
Spring 2006

NONPOINT SOURCE POLLUTION PROGRAM

Pennsylvania's Stephen Foster Lake

Watershed Snapshot

Stephen Foster Lake is located in Mt. Pisgah State Park in the northern mountain region of Bradford County, Pennsylvania. The 70-acre lake with an average depth of 10.5 feet, was created as a result of the construction of a 46-foot high earth and rockhill dam across Mill Creek in 1977. Mill Creek watershed, which encompasses Stephen Foster Lake, is 6, 577 acres in area. More than half of existing acreage is currently used for agriculture. The remaining area is predominantly forested. Stephen Foster Lake watershed contains a total of 15.66 miles of streams.



For many years, the watershed has been a unique and valuable asset for Bradford County. The lake provides recreational opportunities to the community through fishing and boating; Stephen Foster Lake has a reputation as one of the best bass and panfish fisheries in the Pennsylvania State Parks. The surrounding lake area includes picnic grounds, a swimming pool, trails for hiking and exercise, and areas for hunting.

Stephen Foster Lake receives approximately 150,000 visitors annually. In order to keep and increase the amount of visitors to the park, Bradford County knew it needed to address the pollutants that were impacting the lake.

Stephen Foster Lake, Bradford County, PA

Problem

Stephen Foster Lake suffered from a number of water quality impairments and was added to the states list of impaired waters (303 (d) list) in 1996 for nutrient and sediment runoff due to agricultural activities. Excess sediment and nutrients were creating anoxic conditions in the lake. As a result, the lake experienced large unsightly algal blooms that reduce the amount of oxygen available to other organisms, including those fish prized by visitors. The algal blooms would also inhibit boating and fishing activities in the lake. In addition, a biological assessment of Mill Creek conducted by the Bradford County Conservation District (BCCD) in the early 1990's showed impairments in the macroinvertebrate population. In the

spring of 2001, a Total Maximum Daily Load (TMDL) for Stephen Foster Lake was completed and called for a 49 percent reduction of phosphorus and a 52 percent reduction of sediment.

Barnyard runoff and milk house waste infiltration.

Program Highlights

BCCD and the farming community have worked diligently to address nonpoint source pollutant issues in the watershed. In May 1993, the U.S. EPA awarded a Clean Lakes Program grant to the BCCD to study the causes of impairment and demonstrate the benefit of implementing nonpoint source controls. By 1996, as a result of the EPA funded lake study, a Phase I Diagnostic/Feasibility Study/Restoration and Management Plan for long-term protection and preservation of the lake had been completed. By 2004, of the thirteen farms within the watershed, eleven were fully implemented with agricultural best management practices (BMP's). Several BMP's such as stream fencing were constructed for 9 miles above the lake to help prevent cattle wandering into waterways. Agricultural stream crossings were also constructed in order to move cattle across streams swiftly, preventing animals from grazing near the waterway, and consequently destroying stream banks.

Trees and shrubs were planted to establish riparian buffers and 11 waste management systems were built to store manure for proper field application or treat agricultural wastewater in vegetated filter areas. Also, twenty-eight stream structures were installed on Mill Creek about halfway up the watershed as part of a 2,500 ft. stream channel restoration. One alternative water supply was installed and a box culvert outlet was stabilized to reduce further erosion and sedimentation into Mill Creek.

Results

Several computer simulation models were used to examine the current load reductions resulting from the BMPs that have been implemented. With the combination of these efforts, the calculated nutrient runoff was reduced by 52 percent and sediment runoff was reduced by 59 percent, exceeding the reduction recommended in the TMDL.

Mill Creek currently meets designated uses; this assessment was the result of benthic biomonitoring conducted by the Pennsylvania Department of Environmental Protection (PADEP) in 2004 and 2005. The knowledge that stream input to the lake is now unimpaired provides critical information on the effectiveness of BMP's. BCCD continues to implement BMP's to enhance water quality in Stephen Foster Lake. Preliminary water quality data collected in the lake since 2004 reflects slight decreases in the levels of total phosphorus and total suspended solids. of seasonal mixing, resulting in the lake being susceptible to algal blooms.

	1994-1995	2005
Chlorophyll *a*	64	62
Total Phosphorus	70	57
Secchi Depth	58	55

Farm feedlot before and after infrastructure improvements.

Although an intensive amount of work was done above the lake, water quality data will be slow to follow due to the large amounts of sediment and phosphorus that currently reside in the lake. These large amounts of residual phosphorus can become available in the lake as a result of seasonal mixing, resulting in the lake being susceptible to algal blooms.

In order to remove Stephen Foster Lake from the 303(d) list and to improve the appeal of the lake to the thousands of visitors that annually utilize the lake and the surrounding areas, BCCD and the Bureau of State Parks investigated further in-lake treatments that were recommended by the Management Plan. A December 2004 meeting of all stakeholders, including the conservation district, State Parks, Princeton Hydro L.C.C., PADEP and EPA, agreed that in-lake treatment was necessary to further lake water quality improvement for removal of the lake from the 303(d) list. Several options to reduce sediment and phosphorus were discussed; Princeton Hydro was set to task on developing a Recommended Plan of Action after conducting a comprehensive study to examine different treatments based on current (2005) and past water quality data.

Possible treatments include herbicides, dredging, drawdown, aeration, nutrient inactivation, the use of copper based algaecides, weed harvesting and bottom water withdrawal. Several of these options would prove too costly and others, such as herbicide treatment, do not truly address the lake's issues. The results of this study found that for quick results in the short term, State Parks Service will utilize bottom water withdraws to delay stratification and will analyze the use of nutrient inactivation techniques. To address water quality for the long term the most feasible options are artificial circulation and/or conversion of the sediment forebay into a wetland BMP.

To reduce algal blooms and improve water quality while other treatment options are analyzed, Stephen Foster Lake will undergo bottom water withdrawal to delay stratification to reduce the total phosphorus available in the lake. Bottom water will be drained in the spring and early summer prior to the thermal stratification of the lake. The withdrawal will delay stratification of the lake and the accompanying re-suspension of nutrients in efforts to shorten the length of time the lake undergoes anoxic conditions. As the dissolved oxygen (DO) is depleted in bottom waters, dissolved phosphorus is released from the sediment and accumulates in the overlying waters. When mixing occurs (from seasonal temperature changes or high flow input from storms), the water at the bottom of the lake is transported to the surface where it stimulates algal growth in the lake.

The goal of bottom water withdrawal is to minimize the lake's internal phosphorus loading. This process has been approved by PADEP contingent on acceptable dissolved oxygen and iron levels in the stream below the discharge. If successful, this technique could become an annual BMP to improve the water quality in Stephen Foster Lake.

Constructed Wetland for treatment of milk house waste and manure runoff.

Partners and Funding

Back in 1994, the Conservation District, watershed residents, USDA Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), PADEP, U.S. EPA, DCNR's Bureau of State Parks, Chesapeake Bay Foundation (CBF), PA Lake Management Society (PALMS), Coastal Environmental Services and a host of other participants began a process of watershed and lake restoration. Stream and lake monitoring identified, quantified, and targeted impacts on water quality. Funding from DEP, EPA, USDA, CBF, PA Dept. of Ag. and the landowners themselves, combined with the technical assistance provided by the Conservation District, NRCS and CBF to install over $1.2 million dollars in BMP's on the ground. The improvement of this lake brought together several agencies and interested parties. These agencies are working together to examine in-lake treatments to further improve the water quality within the lake. This project demonstrates physical success in the environment, in the education of its citizens and interagency communications and dialogues that brought groups together with the common goal of water quality improvement for Stephen Foster Lake.

Manure and runoff from a previously severely degraded manure handling area is now contained and directed to the new manure storage facility for field application.

Contacts:

Mike Lovegreen
Bradford County Conservation District
District Manager
Mike.Lovegreen@pa.nacdnet.net
(570) 265-5539

Suzanne Hall
U.S. Environmental Protection Agency
Nonpoint Source Program
hall.suzanne@epa.gov
(215) 814-5701

Barbara Lathrop
Pennsylvania Department of
Environmental Protection
Nonpoint Source Program
blathrop@state.pa.us
(717) 772-5651